Feasibility of Inpatient Continuous Glucose Monitoring During the COVID-19 Pandemic: Early Experience

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Continuous glucose monitoring (CGM) systems have been explored in a few studies for non–intensive care unit (ICU) patients (1–3). During the coronavirus disease 2019 (COVID-19) pandemic, shortage of personal protective equipment (PPE) became a concern. On 1 April 2020, the U.S. Food and Drug Administration announced it would not object to the use of CGM systems to assist with COVID-19 patient monitoring (4). This study was conducted to explore the feasibility of using CGM in noncritically ill patients hospitalized with COVID-19.

Non-ICU adult COVID-19–positive patients receiving subcutaneous insulin injection and point of care (POC) glucose testing (Accu-Chek Inform II) were eligible to participate. Exclusion criteria included unstable glucose levels (POC glucose $<$70 or $>$350 mg/dL) at entry, hypotension, significant edema, being on dialysis, being postsurgical or with planned surgery/computed tomography/MRI, and taking hydroxyurea, ascorbic acid, or acetaminophen $>$1 g every 6 h. Participants gave informed consent. The protocol was approved by the Institutional Review Board at the University of Illinois at Chicago.

Dexcom G6 sensor was placed in the lower abdomen by the team physician. iPhone 5S was used as a receiver, placed at the patient's door. The data were transmitted to the Dexcom Follow app in the smartphone at the nurses' station and the investigator's smart devices. Participants continued to receive glycemic management per clinical team's decision. After approximately 24 h, if the sensor and POC values correlated well, the frequency of POC glucose testing was reduced from four times to twice daily (before breakfast and before dinner). Prelunch and bedtime POC glucose were documented from the sensor. Additional POC glucose was performed if clinically indicated.

Nine patients participated (4 male, mean [SD] age 52.6 [15.1] years). Hemoglobin A_{1c} level was 12.0% (2.8%) (108.0 [30.6] mmol/mol). Mean (SD) number of days in the study was 4.3 (3.1). After the sensor was placed for about 24 h, the median (interquartile range) POC tests/day was 3 (2, 4). Mean (SD) POC glucose and sensor values were 218.8 (71.1) mg/dL and 219.3 (51.7) mg/dL, respectively. There were 105 pairs of POC and sensor glucose values. Mean bias was 2.45 mg/dL. The correlation coefficient between POC and sensor glucose values was 0.927. Mean absolute relative difference (MARD) was 9.77%, and 84.8% of the sensor values were in Clarke zone A (5) and 100% were in zone A or B (Fig. 1).

CGM readings prompted five clinical interventions due to high or low glucose values (by alarm and trend glucose). There were no sensor-related adverse events. Sensor use was discontinued at the end of the sensor life in one patient due to the patient becoming hyperglycemic from hospital-acquired pneumonia and standard POC glucose test being resumed. Another patient was transferred to the ICU due to worsening hypoxia, and sensor use was discontinued.

Regarding lessons learned from sensor implementation, the acceptance by nursing staff and communication with the multidisciplinary team was essential. In order to reduce PPE use and staff exposure, the team physicians placed the sensors during rounds. The accessible location of the receiver was important, as the setup was needed after sensor insertion and occasional checks were needed to address data interruptions. Thus, the receiver was placed at the

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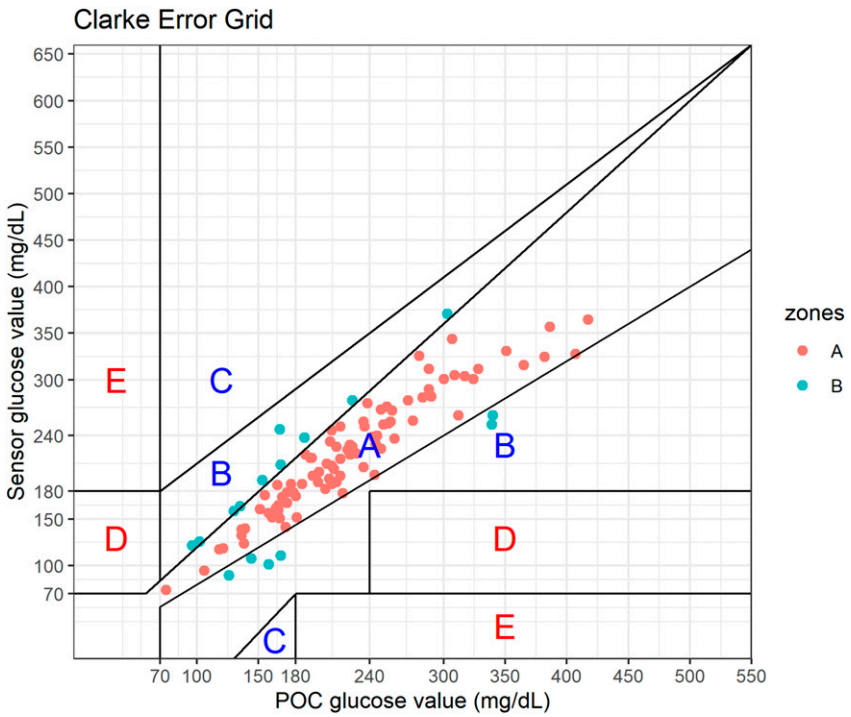

Figure 1—Clarke Error grid demonstrating the relationship between sensor and POC glucose values.

patient's door (instead of at the bedside). Portable power chargers were used as a power source for the receiver. Occasionally, there were short data interruptions on the followers' device, but the data on the receiver were always on display (e.g., there was no sensor failure). Finally, the device at the nurses' station was relatively small and the volume of the alarm was limited to that of the smart device. Investigators assisted in monitoring glucose values remotely and alerted nursing to changes.

In this early experience of using CGM in noncritically ill COVID-19 patients, the POC and sensor values correlated well with a MARD of 9.77%. Although an official count of PPE use was not performed, the median number of POC glucose tests was 3/day, likely reducing PPE use. POC glucose testing was not completely eliminated, and sensor values were used to aid in deciding corrective insulin coverage only. Our pilot data, although small in number, support the use of CGM in noncritically ill patients, similar to previous studies (1–3). We found efforts needed to be invested in ensuring smooth operation of the system. Future improvements should incorporate a true telemetry system with alarms, with direct data incorporation into medical records. The logistics of the receiver location need to be addressed so it could not potentially be separated from the patients and the central monitoring area. Our study is limited by a small number of patients, and their glycemic control was suboptimal.

In summary, this pilot study found that CGM use is feasible in noncritically ill COVID-19 patients. Further confirmation is needed through large randomized clinical trials.

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